Methods: From 105 patients (male gender 79%, age 61.6±11.0 years), the angiographic grade and direction of collateral flow in 121 totally occluded vessels was compared to the transluminal attenuation gradient of vessel distal to total occlusion (TAGdistal) derived from 64-detector row CCTA. TAG is defined as the linear gradient of luminal attenuation along coronary artery, and was validated against angiographical stenosis and flow velocity in our previous study.
Results: TAGdistal increased consistently and significantly with the degree of collateral flow, from -4.43±4.02 HU/mm for Rentrop score 0 to 0.82±1.08 HU/mm for Rentrop score 3 ($p<0.0001$). TAGdistal was also significantly higher in retrograde flow compared to anterograde collateral flow (-2.44±3.04 HU/mm versus 1.33±2.59 HU/mm, $p<0.0001$). The well-developed collateral vessel that have Rentrop score 2 or 3, which was found in 42.1% (51/121), could be predicted by the TAGdistal cutoff value of >= -1.28 HU/mm with area under receiver operating characteristic curve of 0.689, and with a sensitivity and specificity, positive and negative predictive value of 86.3%, 47.1%, and 54.3%, 82.5%, respectively.
Conclusions: As far as we know, this is the first study showing that CT can evaluate coronary collateral flow. Using TAG method, CCTA appears to be able to measure quantitatively the degree and direction of coronary collateral circulation, and predict angiographically well developed collateral vessels. These abilities of CCTA may be useful for evaluation of patients with complex coronary artery disease.

TCT-74

Impact of Pre-Procedural Coronary CT Angiography on the Procedural Success of Percutaneous Coronary Intervention for Chronic Total Occlusion: A Multicenter Study of e-CTO Investigators

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Background: Coronary CT angiography (CCTA) has been used to predict procedural success of percutaneous coronary intervention (PCI) for chronic total occlusion (CTO). However, the role of CCTA on the procedural outcome has not been reported in a large-scaled study. We investigated the impact of pre-procedural CCTA on the procedural success of CTO PCI on a patient-basis.
Methods: We retrospectively compared 2,840 patients without pre-procedural CCTA (no CCTA group) and 658 patients with CCTA (CCTA group) from e-CTO, a Korean multicenter registry comprising 26 centers. Results were further confirmed in propensity-matched subgroup (N=1,316).
Results: CCTA groups were younger (62.1±10.6 vs. 63.1±11.2), more were female (21.9% vs. 27.4%), more had CTO in right coronary artery (45.0% vs. 37.6%, $p<0.05$), and more risk factors. These differences were eliminated after matching of 21 variables. The unadjusted CTO PCI success rate was lower in CCTA group compared to non CCTA group (83.4% vs. 75.2%), and it was consistent in subgroup analyses by lesion location (LAD, 78.4% vs. 85.7%; LCX, 72.5% vs. 84.3%; RCA, 73.3% vs. 80.4%, $p<0.05$). The use of pre-procedural CCTA was related to 0.61-fold decrease of odds for procedural success (95% confidence interval (CI)=0.49-0.74, $p<0.001$) in unadjusted model. This result was confirmed in covariate-adjusted model (OR=0.57, 95% CI=0.45 – 0.71) and in propensity-score matched model (OR=0.61, 95% CI=0.47 – 0.80, $p<0.001$).
Conclusions: Pre-procedural CCTA did not show beneficial impact on the procedural success of CTO PCI in our multicenter registry. Careful selection or sophisticated CCTA analytic methods would be required to demonstrate the clinical role of pre-procedural CCTA before CTO PCI.

TCT-75

Lumen Enlargement of the Coronary Segments Located Distal to Chronic Total Occlusions Successfully Treated with Drug-Eluting Stents at Follow-up

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Background: Chronic total occlusions (CTO) are the final stage of coronary atherosclerosis. Coronary arteries with CTO have shown large plaque burden and negative remodeling of the occluded region and the segments located distal to the occlusion. Lumen and plaque changes located distal to successfully re-canalized CTO remain unknown at follow-up.
Methods: Ninety-one CTO successfully treated with drug-eluting stents in 86 patients underwent quantitative angiography at baseline and 12-18 months follow-up. Thirty-one lesions were investigated with IVUS. All analyses were performed after nitroglycerin. Angiographic changes of were assessed with quantitative coronary angiography as differences in minimal, mean and maximal lumen diameter (MinLD, MeanLD and MaxLD, respectively). Vessel remodeling was assessed with IVUS as changes in lumen, plaque and vessel volume.
Results: At follow-up, MinLD increased 23.9% (from 0.88±0.32 to 1.09±0.35mm: $p<0.01$), MeanLD 16.4% (from 1.59±0.44 to 1.85±0.45mm; $p<0.01$) and MaxLD 11.7% (from 2.39±0.67 to 2.67±0.70mm; $p<0.01$). Lumen enlargement was greater in non-restenotic lesions, small lumen area at baseline and low LDL-cholesterol levels during the study period. By IVUS, lumen increased 26.9% (from 108.1±89.2 to 137.3±115.3mm3; $p<0.01$), vessel increased 12.1% (from 207.1±170.2 to 232.2±196.0 mm3; $p<0.01$) and plaque tended to decrease (-3.9%, from 98.9±88.7 to 94.9±89.3 mm3; $p=0.07$). Small lumen at baseline was related to greater lumen enlargement.
Conclusions: Distal segments to re-canalized CTO show a notable lumen and vessel enlargement with a trend towards of mild plaque regression. Low LDL-Cholesterol levels during the study increases lumen enlargement. Angiographic lesions distal to CTO may change and stent implantation must be discouraged.

TCT-76

Predictive Value of the J-CTO Score in Percutaneous Coronary Interventions for Chronic Total Occlusions

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Background: Introduction The J-CTO score has been shown to predict successful guidewire crossing within 30 minutes in percutaneous coronary intervention (PCI) for chronic total occlusions (CTO) in a multicentre Japanese registry. Hypothesis We assessed the hypothesis that the J-CTO score is a useful risk score for the prediction of procedural failure of PCI for CTO in a different cohort of patients.
Methods: Methods The study included all consecutive patients undergoing PCI for CTO at 3 tertiary PCI centres between January 2004 and December 2011. The J-CTO score assigns 1 point to each of the following: calcification, bending, blunt stump, occlusion length ≥20 mm, and previously failed lesion and classifies lesions as easy (score of 0), intermediate (score of 1), difficult (score of 2), and "very difficult" (score of ≥3). A multivariable mixed effect logistic regression for clustered data was used to assess the impact of J-CTO score on PCI failure. Model calibration was assessed as difference between predicted probabilities with the worst or best prognosis (PSEP). Areas under receiver-operating characteristic curve (AUC) were computed.
Results: Results A total of 1261 patients, median age 63 yrs-old (25th-75th percentile, 55-72), undergoing PCI for 1418 CTO were included. PCI failure occurred in 410 (28.9%) lesions. Failure rate significantly increased with increasing J-CTO score (13.6%, 24.7%, 37.0%, 44.8%, in the groups with J-CTO score of 0, 1, 2, ≥3, respectively, $p<0.001$). At multivariable logistic regression J-CTO score was a significant predictor of failure (odds ratio 1.68, 95% confidence interval (CI) 1.43-1.97, $p<0.001$, for each unit increase in J-CTO score). PSEP was 0.34 and 0.33 in a model containing J-CTO score only, or containing J-CTO score in addition to clinical, procedural variables and vessel site, respectively. The AUC of a model containing J-CTO score only was significantly higher than AUC of a model containing J-CTO score in addition to clinical, procedural variables and vessel site (0.77, 95% CI 0.75-0.80, vs. 0.71, 95% CI 0.69- 0.74, $p<0.001$).
Conclusions: Conclusions The J-CTO score is an independent predictor of failure of PCI for CTO and has a good predictive accuracy as stand-

TCT-77

Initial and Mid-Term Angiographic Outcomes of Septal Channel Perforation Related to Retrograde Recanalization for Chronic Total Occlusions

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Background: Septal channel perforation occurs rarely in retrograde recanalization via septal channel for chronic total occlusion (CTO) lesions. There has been little data on mid-term angiographic outcomes of septal channel perforation.
Methods: Septal channel perforation with cardiac tamponade or spreading myocardial blush was treated with coil or fat tissue to occlude, balloon dilatation at the donor artery, and administration of protamine. Persistent septal channel perforation into the ventricle and coronary sinus or of non-growing myocardial blush was followed up by no treatment. We examined the angiographic outcome of no treatment cases of septal channel perforation.
Results: Between October 2005 and December 2011, we performed the retrograde approach in 465 patients with 484 CTO lesions. Of these, the septal channel was used in 55.2% (267/484), and its in-hospital outcomes were no major adverse cardiac events and 1 cardiac tamponade. The incidence of septal channel perforation was 15.4% (41/267). In septal channel perforation cases, we used the coil (n=5), fat tissue (n=2), balloon dilatation (n=3), and protamine (n=15). Of

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41 lesions, 22 lesions were followed without treatment. Angiographic characteristics of septal channel perforation were Ellis class I (n=14), class II (n=2), and class IIICS (n=6). Septal channel perforation occurred in guidewire (n=13), balloon dilatation (n=8), and microcatheter (n=1). The angiographic follow up rate was 81.8% (class I: n=11, class II: n=2, and class IIICS: n=5). Persistent septal channel perforation disappeared at follow up angiography in all lesions.
Conclusions: Persistent septal channel perforation into the ventricle and coronary sinus or of non-spreading myocardial blush may have a good outcome.

TCT-78

Long-Term (4-Year) Clinical Outcomes of Total Occlusions and Completeness of Revascularisation in the Synergy between Percutaneous Coronary Intervention with Taxus and Cardiac Surgery Trial

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Background: The impact of successful chronic total occlusion (TO) recanalisation and completeness of revascularisation after PCI on long-term survival remains unsettled.
Methods: Within the All-Comers SYNTAX Trial (n=2636), the PCI and CABG arms were stratified by the presence of TOs and complete (CR) vs. incomplete (ICR) revascularisation. Clinical outcomes (Kaplan-Meier) were analysed with log-rank and Cox regression analyses.
Results: In the randomised population, recanalisation/bypass rates of 49.4% (PCI) vs. 68.1% (CABG) were reported. In the All-Comers population, 840 patients (PCI: 26.3%, CABG: 36.4%, p<0.001) with 1007 TOs were identified. The presence of TOs was significantly associated with less CR by PCI (CR: TO 34.3%, non TO 59.8%, p<0.001) and CABG (CR: TO 64.8%, non TO 69.8%, p=0.048). The presence of a TO was the strongest independent predictor of ICR after PCI (Hazard Ratio [95% CI]: 2.85 [2.09, 3.87], p<0.001). Regardless of the presence of a TO in the PCI & CABG arms, CR (compared to ICR) was associated with significant reductions in 4-year mortality, all-cause revascularisation, and MACCE. Four-year stent thrombosis rates in the PCI arm were significantly lower with CR (3.7%) vs. ICR (6.5%, p=0.046), an effect that was more pronounced in the TO group.

Conclusions: Within the PCI and CABG arms of the All-Comers SYNTAX Trial – and specifically in all patients with TOs – whatever the acceptable threshold of revascularisation is appropriate for an individual patient, the identification of ICR (compared to CR) using the SYNTAX Trial definition identifies patients who have an adverse longer-term prognosis.

TCT-79

Chronic Total Occlusions in Sweden – Report from the Swedish Coronary Angiography and Angioplasty Registry (SCAAR)

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Background: Interventions on chronic total occlusions (CTO) demand expert operator skills, longer procedural time and are more frequently associated with complications. Current guidelines for percutaneous coronary interventions (PCI) for CTO are based on small retrospective studies and expert consensus. Consequently, there is a necessity to strengthen such a recommendation with more evidence. The aim of this study was to report and describe prevalence, demographics, clinical characteristics, treatment decisions and trends in reporting on CTO at the level of one whole nation using data from the Swedish Coronary Angiography and Angioplasty Registry (SCAAR).
Methods: SCAAR contains data on all consecutive patients who undergoes coronary angiography or PCI in Sweden since 1989. Diagnosis of CTO in SCAAR is based on two variables. The first variable is PCI physician's mandatory evaluation of whether the treated occluded segment is more than three months old. The second variable is a non-mandatory reporting of lesions % stenosis in coronary artery segments.
Results: In January 2012, the SCAAR registry consisted of 497,572 procedures performed in 348,863 patients. In total, 29,571 patients with a CTO were identified. A CTO was observed in 10.9% of all performed procedures. In patients with significant coronary lesions, a CTO was seen in 15.9%. CTO patients had more cardiovascular risk factors and more extensive coronary artery disease. The majority of CTO patients were treated conservatively and PCI revascularization of CTO is performed only in 5.8% of all procedures. Revascularized CTO patients were younger and had more severe symptoms while CTO patients with diabetes and multivessel disease were more likely to be referred to CABG.
Conclusions: SCAAR is the largest data base of CTO patients to date. CTO is a frequent finding in patients undergoing coronary angiography in Sweden and the number of CTO procedures has been constant over the last 13 years. SCAAR may be a valuable source of relevant clinical data in the process of building the real world evidence for the guidelines regarding the optimal treatment of CTO patients.

TCT-80

Incidence of Periprocedual Myocardial Infarction in Chronic Total Occlusion PCI and Impact on Clinical Outcome

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Background: Periprocedual myocardial infarction (PMI) in percutaneous coronary intervention was reported to associate with increased risk of death in long-term follow-up. However, there is a paucity of information about PMI in patients undergoing percutaneous coronary intervention for chronic total occlusion (CTO-PCI). In this study, we investigated incidence, predictors of PMI and prognostic impact after CTO-PCI.
Methods: We reviewed our CTO-PCI database and examined the incidence of PMI in patients who had attempted CTO recanalization between 2003 and 2009. PMI was defined as an increase of CK or CK-MB level more than three times higher than normal limit in measurement within 24 hours after index procedure. All cause mortality was estimated at 5 years (median: 2.5 years; interquartile range: 1.8 to 3.5 years) according to Kaplan-Meier analysis.
Results: Nine hundred and forty-five patients underwent CTO-PCI (mean age 63 +/− 10 years old; 89% male) were enrolled. Overall procedure success rate was 70%. PMI was observed in 53 (5.6%) of all patients and occurred more in failed patients than in successful patients (7.1% vs 5.0%, p=0.2). PMI patients had significantly less prior history of myocardial infarction and of PCI and less hypercholesterolemia. CTO lesions related to PMI were located less frequently in-stent and more in the contest of multivessel disease compared to lesions without PMI. At 5 years follow-up, patients with PMI showed significant higher rate of mortality compared to that without (29% vs 9 %, p=0.0006). At multivariate analysis, PMI (HR: 2.95, 95%CI: 1.27 to 6.02, p=0.014), age (HR: 1.09, 95%CI: 1.06 to 1.12, p<0.0001), chronic kidney disease (HR: 4.47, 95%CI: 2.38 to 8.10, p<0.0001) and left ventricular ejection fraction (HR 0.94, 95%CI: 0.92 to 0.96, p<0.0001) were significant predictors of all cause mortality.
Conclusions: In our registry, PMI was observed in 5.6% of CTO-PCI. PMI was an independent predictor of all cause mortality in long-term follow up. From these data, we don't determine if PMI is a marker of more advanced disease or a true causative factor.